

Central haemodynamics for the therapeutic management of hypertension



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Shanghai, China
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MENZIES
Institute for Medical Research

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AMA accepts recommendation for
Category 1 CPT Code for arterial
pressure waveform assessment

application by the Renal Physicians Association

This code is reserved for procedures
with demonstrated clinical efficacy, are
performed by many clinicians across
the US and, have US FDA approval



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REVIEW

Central pressure should not be used in clinical practice

Gary F. Mitchell*



Thus, currently available evidence does not provide sufficient justification for widespread adoption and routine use of central pressure measurements in clinical practice.

Tonometry central BP



Brachial cuff central BP



WHO ESH AHA JSH
Practical Evidence Practical Evidence Practical Evidence Practical Evidence



Cuff-derived central BP

Devices available	Pro's	Con's
<ul style="list-style-type: none"> • SphygmoCor XCEL (AtCor, AU) • Mobil-o-graph (IEM, DE) • Watch BP Office Central (Microlife, CH) • Centron cBP301 (Centron, UK) • Vicorder (Skidmore Medical, UK) • Cardioscope II (PulseCor, NZ) • Arteriograph (TensioMed, HU) 	<ul style="list-style-type: none"> • Ease of use • Patient and doctor familiarity • Non operator dependent • Possibility for 24 hour ambulatory central BP and in-clinic automated BP (as per Myers) 	<ul style="list-style-type: none"> • Minimal hard outcome data • *Validation (methods and calibration by brachial BP) <p>*strong criticism</p>

Validation studies of brachial cuff central BP devices

paper	DEVICE	Oscillometric recording at	method	calibration	REFERENCE	Nb of subjects	Reported error on cSBP in mmHg (m±sd)
Park 2014 [112]	PulseCor R6.5	20mmHg above SBP	PM	Device own calibration	SphygmoCor calibrated to bSBP and bDBP	1107	3 ± 6
					SphygmoCor calibrated to MAP and bDBP	1107	-5 ± 8
					Invasive pressure tip	6	-5 ± 8
Stoner 2014 [111]	PulseCor R7	30mmHg above SBP	PM	Device own calibration	SphygmoCor calibrated to MAP and bDBP	57	-4, 5 ± 2, 4
Agnoletti 2014 [115]	Centron cBP301	(DBP - DBP)0	TF	MAP & bDBP	SphygmoCor calibrated to bSBP and bDBP	33	0.3 ± 3.3
Shih 2014 [102]	Prototype using Microlife WatchBP	60mmHg	TF	bSBP & bDBP	Invasive pressure tip	40	0.1 ± 3.5
	Prototype using Colin VP2000	60mmHg	TF	bSBP & bDBP	Invasive pressure tip	100	-0.6 ± 7.6
Rossen 2014 [108]	Arteriograph	25mmHg above SBP	WA	Device own calibration	Fluid filled catheter	22	4.4 ± 8.7
Cheng 2013 [106]	Prototype using Microlife WatchBP	60 mmHg	WA	bSBP & bDBP	Fluid filled catheter	85	-4.3 ± 3.5
Shih 2013 [100]	Prototype using Microlife WatchBP	60 mmHg	TF	bSBP & bDBP	Invasive pressure tip	40	-4.2 ± 7.2
	Prototype using Colin VP2000	60 mmHg	TF	bSBP & bDBP	Invasive pressure tip	100	-3.0 ± 7.7
Pucci 2013 [37]	Vicorder	70mmHg	TF	Invasive MAP & DBP	Fluid filled catheter	50	-4.0 ± 7.4
				bSBP & bDBP			-6.4 ± 7.4
				bSBP & bDBP	SphygmoCor calibrated to SBP & DBP	90	-6.2 ± 4.6
				bMAP & bDBP	SphygmoCor calibrated to MAP & DBP		-0.5 ± 3.3

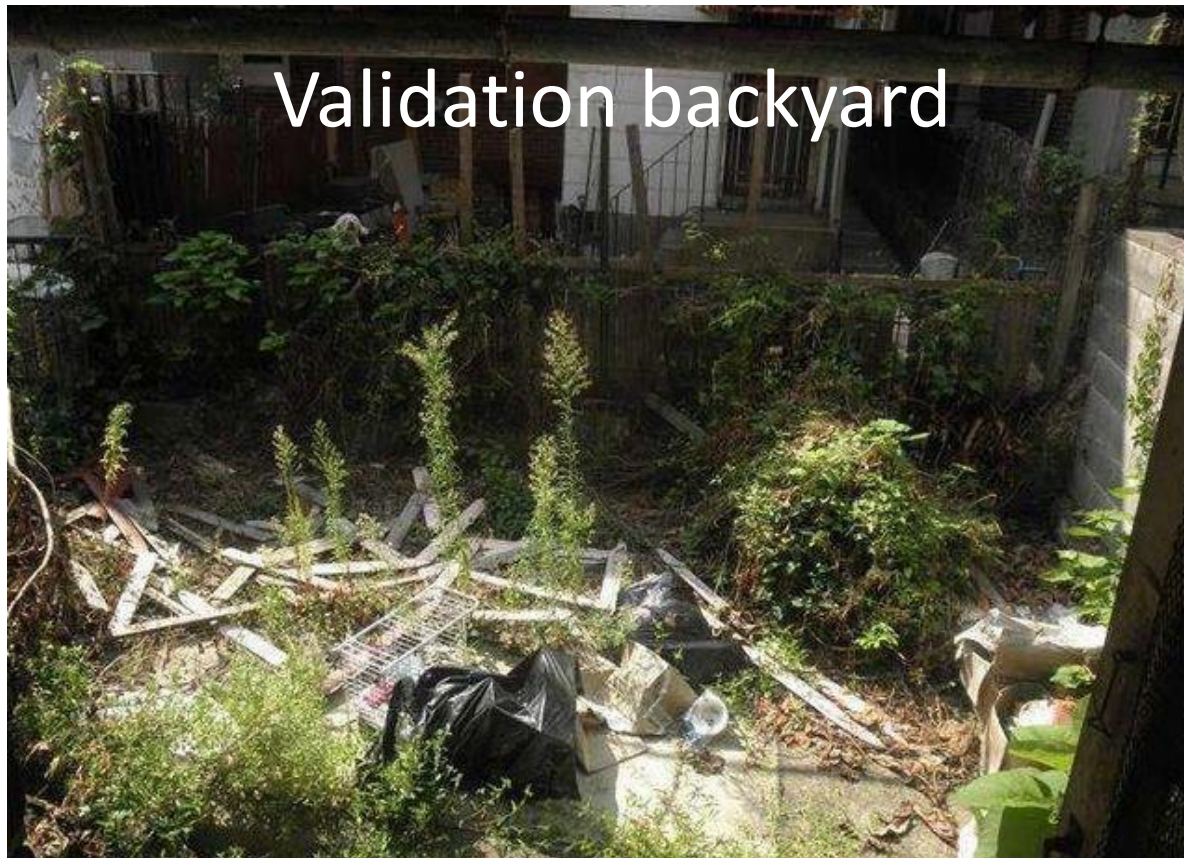
Validation studies of brachial cuff central BP devices cont'd

paper	DEVICE	Oscillometric recording at	method	calibration	REFERENCE	Nb of subjects	Reported error on cSBP in mmHg (m±sd)
Van Dijk 2013 [116]	Arteriograph	35 mmHg above SBP	WA	Device own calibration	Sphygmocor calibrated to bMAP & bDBP		-13.5 ± 15.3
Brett 2012 [67]	Centron cBP301	(SBP+DBP)/2	TF	Invasive MAP & DBP	Invasive pressure tip	29	0.0 ± 5.9
				bMAP & bDBP	Sphygmocor calibrated to bMAP & bDBP	100	-0.6 ± 3.9
				bSBP & bDBP	SphygmoCor calibrated to bSBP & bDBP		1.6 ± 4.5
Butlin 2012 [103]	SphygmoCor XCEL	10 mmHg below low DBP	TF	Device own calibration	SphygmoCor calibrated to bSBP & bDBP	30	0.5 ± 1.8
Climie 2012 [71]	PulseCor R6.5	30 mmHg above SBP	PM	Device own calibration	SphygmoCor calibrated to bMAP & bDBP	47	1.2 ± 2.2
Gunjaca 2012 [70]	Arteriograph	35 mmHg above SBP	WA	Device own calibration	SphygmoCor calibrated to bSBP & bDBP	1012	8.8 ± 7.3
Lin 2012 [107]	PulseCor R6.5	30 mmHg above SBP	PM	Invasive MAP & DBP	Fluid filled catheter	37	2.8 ± 3.9
				Device own calibration			0.25 ± 6.3
Luzardo 2012 [69]	Mobil-o-graph (ARCsolver)	DBP level	TF	Device own calibration	SphygmoCor (calibration not specified)	35	-1.2 ± 3.1
Weiss 2012 [68]	Mobil-o-graph (ARCsolver)	DBP level	TF	Device own calibration	SphygmoCor (calibration not specified)	100	0.5 ± 4.5
Nurnberger 2011 [66]	Arteriograph	35 mmHg above SBP	WA	Device own calibration	SphygmoCor calibrated to bSBP & bDBP	44	3.7 ± np (supine) 10.0 ± np (sitting)
Weber 2011 [39]	Mobil-o-graph (ARCsolver)	DBP level	TF	Invasive MAP & DBP	Invasive pressure tip	30	3.0 ± 6.0
				bMAP & bDBP			-3.0 ± 9.5
				bSBP & bDBP			14.4 ± 9.7
				bMAP & bDBP	SphygmoCor calibrated to bMAP & bDBP	111	-0.5 ± 4.7
				bSBP & bDBP	SphygmoCor calibrated to bSBP & bDBP		0.3 ± 4.2

Since 2009

- 22 'validation' studies
- 3 different reference standards
 - 14 vs invasive catheter (7 fluid filled)
 - 16 vs non invasive device (all SphygmoCor)
- >10 calibration methods
- Variability range -0.1 ± 3.1 to -13.5 ± 15.3

How do we interpret 'validation' data?
How do we know a device will perform
clinically better than brachial cuff BP?

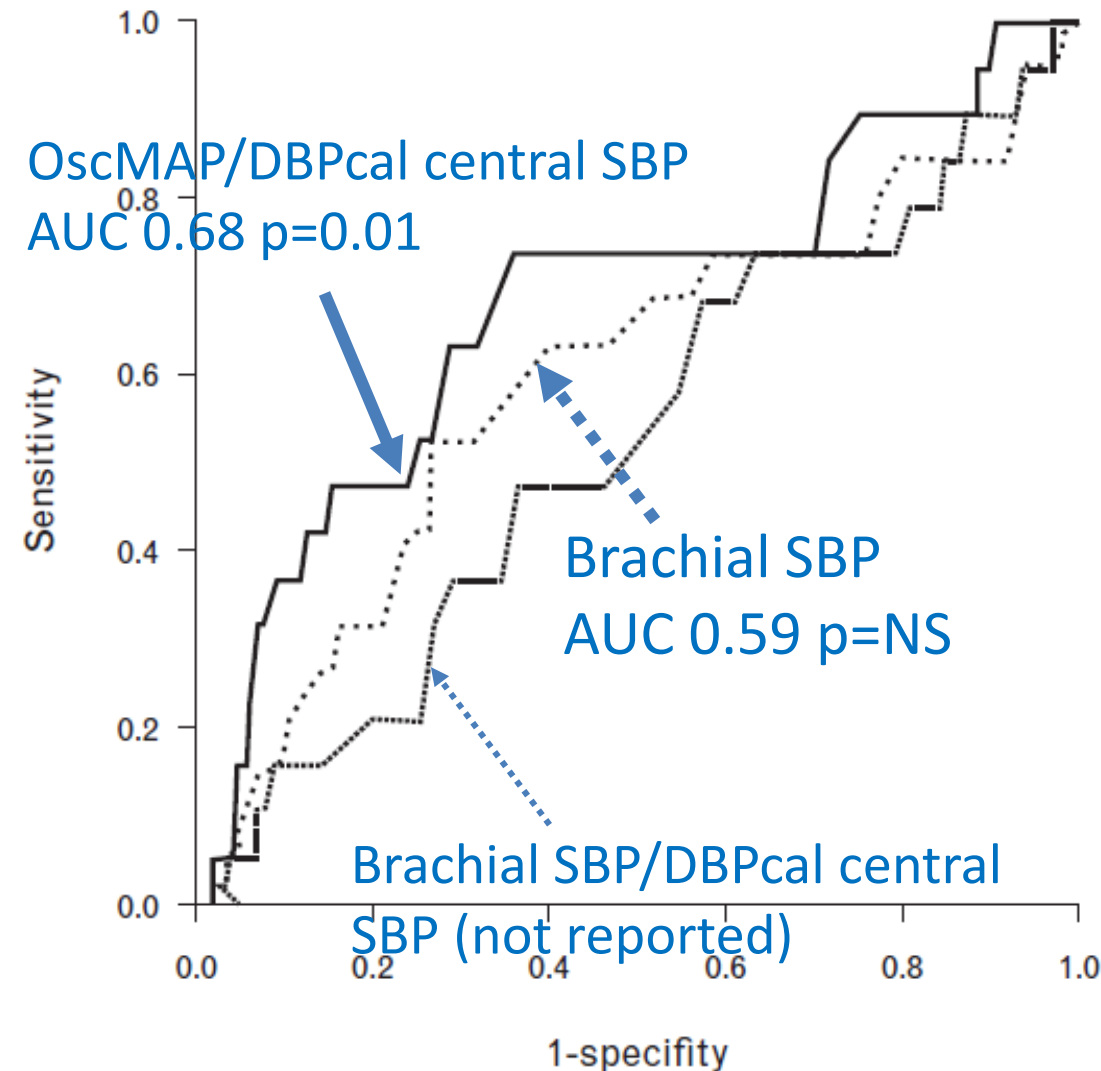


Influence of calibration

Calibration method	Mean difference from invasive cSBP
Brachial oscillometric SBP/DBP	-14.4 ± 9.7
Brachial oscillometric MAP/DBP	3.0 ± 9.5
Invasive MAP/DBP	-3.0 ± 6.0

Assessment of systolic aortic pressure and its association to all cause mortality critically depends on waveform calibration

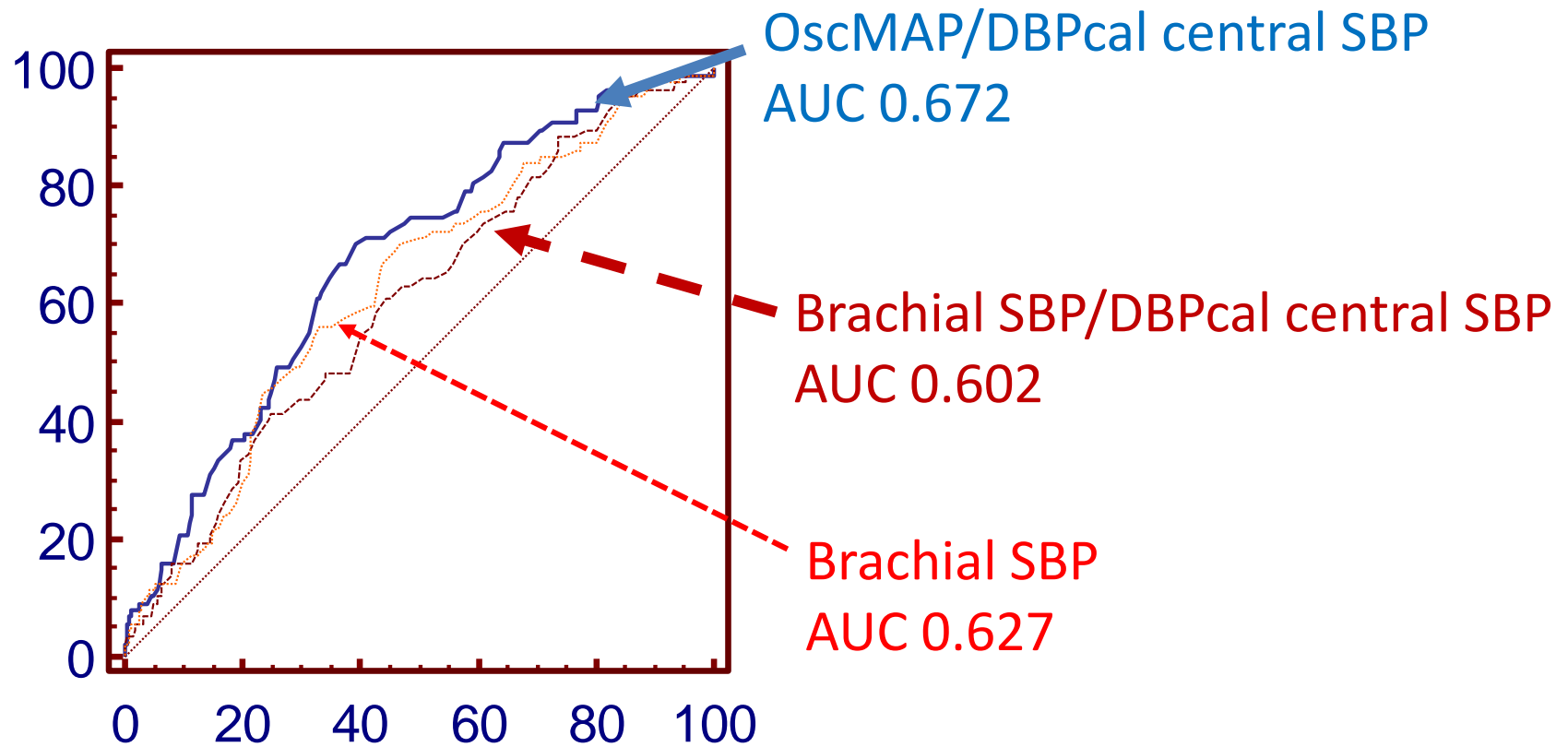
Wasserteurer S. et al, J Hypertension 2015 In Press



159 CKD patients

Discriminatory power
to predict mortality

Discrimination of LVH (n=329; 87 with LVH)

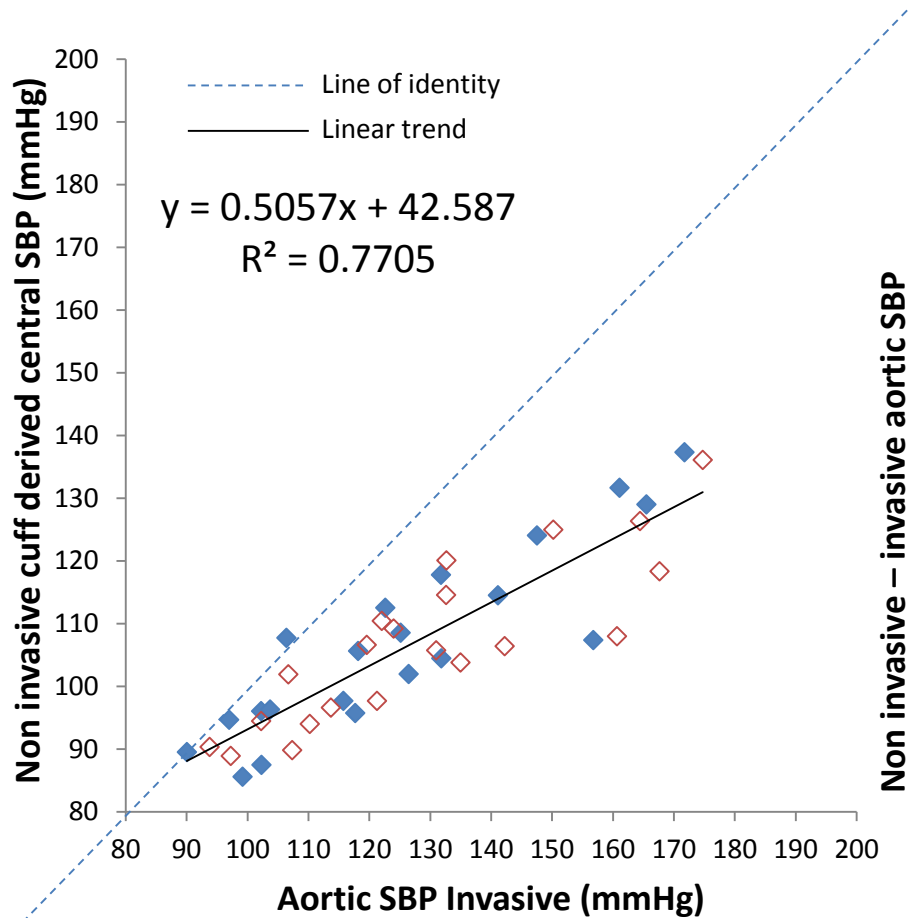


ROC comparison-Pair for discriminating LVH		P-value
OscMAP/DBPcal central SBP	Brachial SBP/DBPcal central SBP	0.0069
OscMAP/DBPcal central SBP	Brachial SBP	0.0261

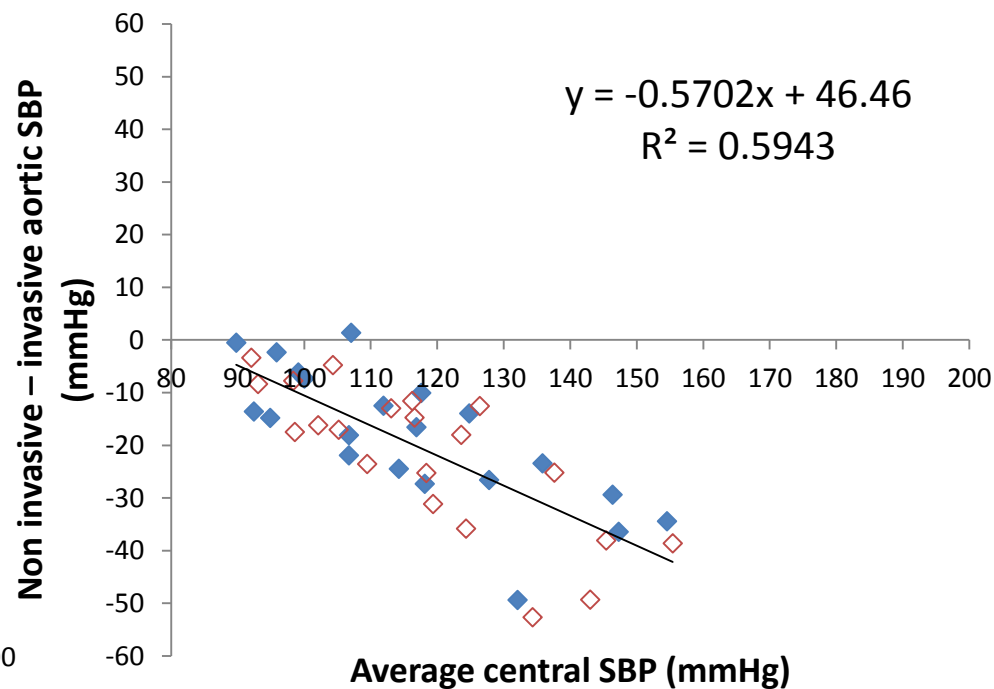
Dr Kazuaki Negishi, Menzies, Tasmania

Should all brachial estimated central BP devices be calibrated with oscillometric MAP and DBP to derive a more accurate central SBP estimate?

Estimated central SBP (other device calibrated with brachial OscMAP/DBP) vs. invasive aortic SBP

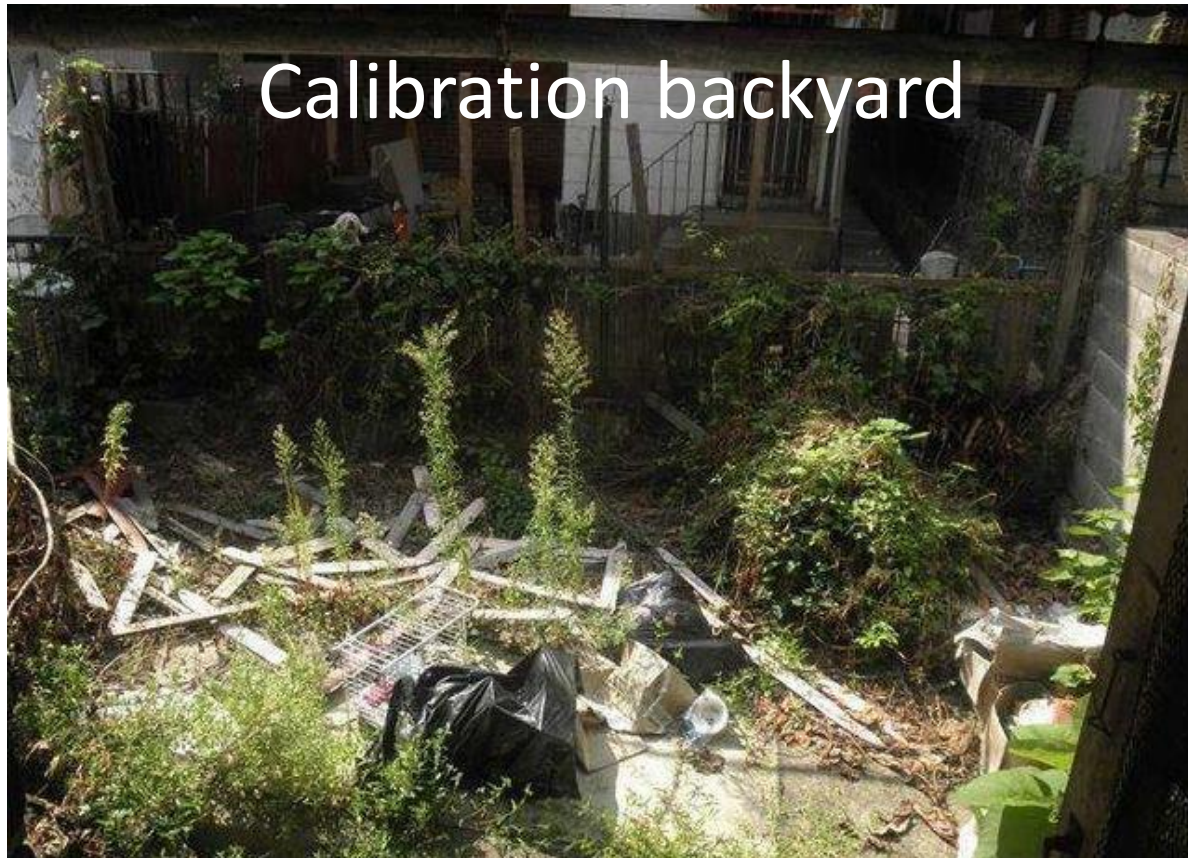


Invasive cSBP	Non invasive cSBP	Difference
127.2 ± 23.7	106.9 ± 13.7	-20.3 ± 13.4



Accuracy of estimated central SBP is influenced by calibration and is device specific

Need international consensus to standardise







Menzies BP Clinic

← → M+ http://www.menzies.utas.edu.au/article.php?Doo=ContentView&id=1840

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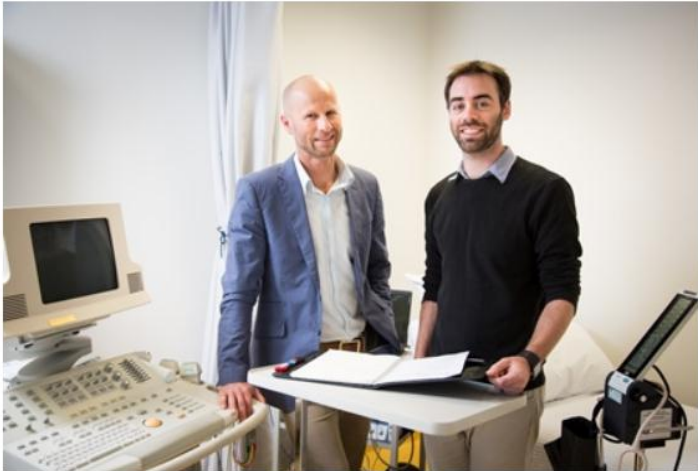
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- The Menzies Blood Pressure Clinic**
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●●●●● Research / The Menzies Blood Pressure Clinic

The Menzies Blood Pressure Clinic



Referral Form

The Menzies Blood Pressure Clinic is a bulk-billed clinical service operated by the Menzies Institute for Medical Research. This clinic utilises the latest methods dedicated to the investigation and management of high blood pressure.

Patients referred to the clinic undergo various blood pressure testing; including clinic measurements, home measurements and

Menzies Blood Pressure Clinic Referral Form



Private Bag 23, Hobart, Tasmania 7001
Ph: +61 3 6226 4710
Fax: +61 3 6226 7764
email: Menzies.BPClinic@utas.edu.au

For the referral of patients with difficult to treat hypertension for further assessment and management recommendations. All our services are bulk-billed. Please return completed referral form by fax, post or email.

This form is also available electronically as a template for Medical Director and Best Practice software from Tasmania Medicare Local (www.tasmedicarelocal.com.au/search/node/menzies).

Referring Doctor Details

Name Provider #
Practice
Address
City/Suburb Post Code
Phone Fax

Patient Demographic Information

Name DOB Gender
Home Address
City/Suburb Post Code
Home Phone Work Phone
Mobile Email

Health Summary Report

Please provide a brief summary of the patient's health:

Latest clinical BP measurements	Date	Blood pressure
	<input type="text"/>	<input type="text"/>

Allergies, reactions and other pertinent information

Investigation Results

Please attach any investigations/results pertaining to target organ damage / secondary hypertension (ie renal function tests, echocardiography, ECG, urine ACR, other relevant tests)

Menzies BP Clinic

Staffed by volunteer specialists

Bulk billed service (Clinic co-ordinator)

People with 'difficult to treat hypertension'

Comprehensive investigation & risk assessment with plan for return to GP care

Brachial and central 24-hour BP, 7-day home BP, in-clinic automated BP (15 min AOBP)

Underpinned by research (data linkage)



47 y.o male, clinic BP 160/105 mmHg (GP measured) – no current Rx.

15-min AOBP 139/76 mmHg cSBP 129 mmHg

No.	Date	Time	Sys	MAP	Dia	Hr	cSys
1	11/03/15	13:37	140	110	84	65	131
2	11/03/15	13:40	141	110	85	65	133
3	11/03/15	13:42	144	98	60	64	129
4	11/03/15	13:44	138	106	78	65	129
5	11/03/15	13:46	144	106	74	64	133
6	11/03/15	13:48	138	105	77	63	130
7	11/03/15	13:50	137	105	78	64	127
8	11/03/15	13:52	133	101	73	66	124

PLAN

Active management, with personal (lifestyle) in the first instance prior to Rx.

82 y.o male, clinic BP 182/80 mmHg (GP measured) – quintuple therapy; AF

15-min AOBP 155/83 mmHg cSBP 130 mmHg

No.	Date	Time	Sys	MAP	Dia	Hr	cSys
1	05/03/15	09:30	173	128	90	57	149
2	05/03/15	09:32	168	124	86	56	146
3	05/03/15	09:34	161	121	88	57	--
4	05/03/15	09:36	157	117	83	55	132
5	05/03/15	09:38	147	110	79	53	124
6	05/03/15	09:40	145	109	79	54	124
7	05/03/15	09:42	143	108	78	54	118
8	05/03/15	09:44	149	111	78	53	120

PLAN

Well managed. No additional therapy needed.



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REVIEW

Central pressure should be used in clinical practice



James E. Sharman*

The identification of some methodological and technical issues could jeopardise progression of the discipline and underscores the imperative for international collaboration to provide guidance.

To be continued.....